

QUARTERLY PROGRESS REPORT

DRD 875MA-003

2003 - September 2003

**Marshall Space Flight Center
Safety and Mission Assurance Mission Services Contract
NAS8-00179**

Approved:

Original Signed By:

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1.0 INTRODUCTION

Hernandez Engineering, Inc. (HEI) successfully performed all required activities and tasks, as described in this report, in fulfillment of their Safety and Mission Assurance (S&MA) Mission Services Contract (NAS8-00179) with NASA's Marshall Space Flight Center (MSFC). This report covers a three-month period of the contract's fourth quarter of the second option year: July 2003 through September 2003.

2.0 GENERAL MANAGEMENT

2.1 Data Requirements

The fourth quarter of the second option year of the S&MA Mission Services contract was successfully completed on September 28, 2003. All Data Requirements (DR) Documents were submitted on or ahead of schedule throughout the quarter. They included DRD 875CD-001 On-Site Employee Location Listing; DRD 875MA-002 Financial Management Reports; DRD 875MA-003 Progress Reports (Monthly/ Quarterly); DRD 875MA-006 Operations Plan, Problem Assessment Center (PAC); DRD 875MA-007 Quarterly Open Problems List; DRD 875MA-008 Monthly Newly Opened/Closed Problem Summary; DRD 875SA-002 Mishap and Safety Statistics Reports; and Quarterly Safety Performance Evaluation.

2.2 Personnel Status

(b)(4)

3.0 BUSINESS MANAGEMENT

We have experienced no financial or business management problems during this period. We attribute this to close attention to details, effective use of established controls designed to efficiently respond to program changes---both anticipated and unexpected---and the continuing support of our corporate financial group's dedicated efforts at controlling overhead expenses.

The contract continues to have a total cost underrun at the end of this period---see the September 2003 Monthly Financial Report, DRD 875MA-002, for specifics. Attachment 2, Man-Hours Expended, of this report contains a description, by major task, of the total man-hours expended this period.

(b)(4)

4.0 PERFORMANCE OF WORK AND USE OF FACILITIES AND EQUIPMENT

4.1 Safety

4.1.1 Industrial Safety (IS)

The Industrial Safety (IS) group performed 153 OSHA compliance annual facilities inspections

and provided all required reports in a timely manner. Also, IS performed 750 construction site compliance inspections to monitor adherence to OSHA and MSFC safety standards. All facility safety violations were documented in the HAZTRAK databases in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements. IS performed other activities such as: (1) participated in three pre-construction conferences; (2) participated in 10 final safety inspections of facilities under renovation or construction; (3) reviewed 91 sets of facility design drawings for compliance with OSHA and consensus codes; (4) assisted QS50 develop and process, for web page posting, five safety bulletins and two Shop Talk safety information topics; and, (5) performed two annual fire drills.

Regarding the assigned Area of Emphasis to increase awareness of identifying Unsafe Acts in the workforce, IS identified 36 Unsafe Acts with emphasis on on-the-spot corrections. In addition to identifying unsafe acts, IS prepared a draft article to the Marshall Star addressing the importance of all civil service and contractor supervisors to increase vigilance in identifying the unsafe acts that occur in their respective work places. To assist in this effort HEI continued to provide (b) (4) to assist the Industrial Safety Department (ISD) identify Unsafe Acts. In addition, this same (b) (4) surveyed 296 locations and monitored construction and maintenance activities after normal work hours and weekends to assure adherence to Lockout/Tagout requirements when working on energized systems. During the last month of this reporting period, HEI also hired another (b) (4) to assist ISD develop a training requirements plan/matrix for all full-time employees, regular and infrequent vendors, visitors, etc. and, a (b) (4) to catalog electronic files previously scanned from hard copy hazardous operation analyses reports.

IS continued to provide a (b) (4) to assist the SHE Communications and Training Teams and general communication of safety awareness to all MSFC employees, assistance also included: (1) wrote several safety articles for publication in the Marshall Star; (2) prepared and processed, for web page posting, the weekly SHE highlights and monthly SSWP safety required and optional focus topics; (3) prepared monthly SHE communications plans; (4) developed multiple innovative safety awareness communications materials including safety announcement on MSFC TV; (5) prepared numerous safety materials to include posters and handouts for the planned MSFC Safety Day scheduled for 10/08/03; and, (6) prepared numerous draft letters of appreciation for the Center Directors signature to recognize MSFC employees, contractors, and guest speakers for their contributions to Safety Day 2003

IS initiated, completed or followed-up on more than 15 hazard analyses which included: (1) performed a safety assessment (SA) for the B-Axial Tension panel testing planned in building 4572; (2) performed a SA for newly purchased Kawasaki mule ATV's; (3) performed a SA for the GEM electric cars; (4) continued to perform a SA for the high visibility Propulsion Research Laboratory (PRL), now under construction; and, (5) provided safety support for the testing of the 24-Inch and 48-Inch Motor firings.

IS continued to support the implementation of the NASA lifting standard, NASA-STD-8719.9 by providing day-to-day advice and assistance to S&MA customers. HEI served as the safety monitor for the transportation and handling operations of the GP-B from Moffet, CA to

Vandenburg, CA; and, advised civil service and contractor managers, supervisors and employees on requirements for lifting equipment proficiency testing in support of the MSFC Personnel Certification Program. In support of a new task to administer proficiency exams to contractor operators, as well as civil service operators of overhead cranes, fork lifts, small truck mounted hoists, and aerial lifts, IS administered hands-on proficiency examinations to two aerial lift, 34 overhead crane, and 39 forklift operators in support of the MSFC Personnel Certification Program.

As a continued significant strength, IS continued to provide dedicated, full-time safety and quality support to the MSFC Test areas, support included: (1) review and approved multiple operating and test procedures; (2) supported the planning for the Goddard Rocket Replica firing; (3) assisted QS50 investigate a close call concerning the proper Lockout/Tagout of an electrical panel for building 4590; (4) served as the safety monitor for the 24-Inch Motor; (5) reviewed the Quantity-Distance calculations for the Multi-Element Injector testing at Test Stand 115; and, (6) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

HEI supported the SSC NASA S&MA effort by participating in design reviews, facility upgrades, weekly telcons, technical interchanges, sidebars, scheduling meetings and delta tabletop discussions regarding projects/programs such as: RS-84 Subscale Preburner, RS-84 Subscale Main Injector, RS-84 Full-Scale Battleship, TR107 and Hybrid Technology Test Task.

A System Hazard Analysis was completed regarding the RS-84 Subscale Preburner test program. A signed copy of the report is in order, ready to be forwarded to Central Engineering for filing. However, the Main Injector test program is under review and will require an addendum to the report.

The process of reviewing the Northrop Grumman Space Technology, Oxygen Rich Preburner project is underway. This is in accordance with preparing a facility system hazard analysis to support the Safety Review Team, Test Readiness Reviews and test operations.

HEI began the process of reviewing the Hybrid Technology Test Task project. This is in accordance with preparing a facility system hazard analysis to support the Safety Review Team, Test Readiness Reviews and test operations.

4.1.2 System Safety Engineering

System Safety Engineering (SSE) participated in the MSFC off-site review of the OSP Level II requirements. SSE is reviewed drafts of OPS Level II requirements for changes impacting the vehicles overall design safety. SSE team participation included developing and providing comments and changes to the SRD, OCD, HRP, and OSP/ISS IRD to a Program level board for resolution. The SSE provided references to existing requirements and rationale to response to Orbital Space Plane (OSP) Program safety related questions and comments. The team developed solutions to issues and provided rationale, both pros and cons, to allow board decisions. SSE clarified wording of the OSP Program's approach to safety requirements addressing fault tolerance.

SSE provided paragraphs relating the expectations for safety during all flight for the Operations Concept Document (OCD). The paragraphs addressed specific expectations through all flight and landing phases including all abort and escape modes, until the arrival of medical assistance. Comments and changes are being coordinated with the owners of the OCD and safety representatives from different NASA Centers.

SSE supported Technical Interchange Meetings (TIMs) and reviews of the three major contractors to gain additional insight into the various designs. The TIMs were very advantageous to both NASA and the contractors by providing a forum for discussion of the overall safety philosophy for the OSP System and providing feedback on specific questions to contractors.

SSE supported the OSP Program by assisting in development of eight draft Data Requirement Documents (DRDs) related to safety. The DRDs require a Program Assurance Plan, System Safety Plan, Hazard Analysis, Software Hazard Analysis, Fault Tree Analysis, Mission Safety Assessments, Mishap Reporting, and Off-Site Contractor Safety Plans. Supplementary DRDs have been identified and are being generated. Supporting language for the Statement of Work (SoW) and rationale were also delivered with the applicable DRDs to the OSP Program.

SSE developed draft Statement of Work (SoW) language to evoke the OSP safety DRDs. Language was also developed for additional DRDs necessary post PDR.

SSE developed an OSP top-level fault tree depicting most probable catastrophic hazards. This was in response to an ASAP request. SSE also developed a draft OSP Program Safety Review Panel Charter.

SSE reviewed the Draft Hazard Analysis and Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) analysis documents from two major OSP contractors. The FMEA/CIL analysis of both contractors were more mature than the Hazard Analysis. In many cases a hazard cause was not listed for identified hazards. Often the phases that the hazards would apply and the severity were not documented or incomplete. Both analysis failed to show sufficient evidence that the analysis had matured to the appropriate level for hazards associated with crew abort and escape modes. Comments of the reviewed plans and analysis were forwarded to the appropriate S&MA leads. It was recognized that this submission of these specific deliverables were de-emphasized by NASA for the contract period.

SSE supported the X-37 Program through documentation review and participation in meetings including the X-37 Approach and Landing Test Vehicle (ALTV) Flight Termination System Meeting, the System Safety Working Group (SSWG) which included a Dryden Flight Research Center (DFRC) Range Safety Office representative that presented the baseline hazard reports for the B-52 Carrier Aircraft, the ALTV Technical Review Board Meeting and other standing meetings.

SSE participated in the EWR 127-1 Tailoring Working Group meeting for the X-37 Orbital Vehicle (OV) at Boeing in Huntington Beach, California. The tailoring team completed most of section 3.12, "Flight Hardware Pressure Systems and Pressurized Structures". The team was not

able to complete Section 3.12.4, "Flight Hardware Special Pressurized Equipment Design, Analysis, and Test Requirements" because there were several findings brought forth to the team concerning the Gaseous Helium (GHe) pressure system.

SSE participated in numerous Demonstration Of Autonomous Rendezvous Technology (DART) Project telecons and meetings related to the selection of new S-band transmitters. The DART Project is procuring two different models of missile grade transmitters and test to simulate all expected environments. If both fail the contingency plan is to utilize the best S-band transmitter and one that can utilize TDRSS to transmit data during activities in the vacuum environment. The project is currently focusing on the S-band transmitters but plans to also quickly select one to utilize TDRSS to mitigate test failures of the selected transmitters.

SSE supported QS20 Return to Flight (RTF) activities by direct daily interactions with numerous MSFC groups, other NASA Centers, and element primary and secondary contractors. SSE support included participation in numerous team and review meetings; reviewing safety plans, accepted hazard analysis, test plans, and plans to address RTF actions; performing reassessments of hazards; and, supporting redesign and safety assessments of special issues for the External Tank (ET), Reusable Solid Rocket Motor (RSRM), Solid Rocket Booster (SRB), and Space Shuttle Main Engine (SSME) Programs.

SSE supported the ET RTF Bipod Redesign efforts by participation in a one day Technical Interchange Meeting (TIM) on 07/10/03 to discuss Verification Test Plans for the Thermal and Structural Bipod Tests.

SSE attended a SSRP TIM on 07/29-31/03 at Michoud Assembly Facility (MAF) held for coordinating the currently proposed ET Hazard Analysis and FMEA/CIL RTF efforts/activities by Lockheed Martin (LM) and NASA.

SSE also participated in a Thermal Protection System (TPS) Verification Assessment TIM on the week of 08/11/03, Thermal Testing at Eglin AFB on 09/15/03, the Protuberance Air Load (PAL) Ramp Assessment Team coordination efforts at the Arnold Engineering Center (AEDC) and daily RTF status meetings.

On 8/11-15/03, System Safety Engineering (SSE) provided support for the ET Hazard Analyses reassessment effort underway for Return-to-Flight (RTF). ET was tasked to reassess all "accepted risk" hazard reports of which they have four which are to be reassessed and provided for SSRP review on 10/15/03: (1) E.03 Lightning; (2) S.09 Hydrogen Venting in Flight; (3) S.10 Partially Open GO2/GH2 Vent/Relief Valve Indicated Closed; and, (4) T.02 Loss of TPS.

SSE participated in review of HR E.03, the Safety Analysis Report (SAR) for the ET Camera System, the MAF Cell A modification safety assessment, integrated hazard reports, final internal review of revised Accepted Risk (AR) Hazard Report (HR) E.03, S.09 and S.10 and provided comments as necessary. Several issues were identified requiring further data enhancement/clarification to the HRs during the review that may result in delay of the release of the document to NASA MSFC for independent review prior to submittal to ET RTF/Level III CCB.

SSE continues to work with Material and Properties (M&P) and LM Engineers to finalize the loads and angularity requirements for the Structural Certification Testing of the Bipod. Once the requirements are determined the plan will be signed off and we will certify the Bipod to the proper structural criteria.

SSE is actively involved with each Program Requirement Change Board (PRCB) RTF actions. SSE has completed a thorough evaluation of 22 out of 22 "accepted risk causes" for debris, waivers, NSTS 22254, controls, and 4x3 matrix classification. SSE supported the 09/16-17/03 SSRP meeting at Thiokol's Utah plant to review all accepted risk causes. SSE activities also include closing five PRCB actions, conducting a review of all Level III CIL waivers, reviewing HR failure causes related to RSRM rollout operations.

SSE reviewed the Process Failure Mode Evaluation Analysis for vertical inspection of the 26 segments currently at KSC and participated at an inspection demonstration in 09/03 at KSC to verify that all requirements could be satisfied. A presentation was prepared and delivered to QS10 on the vertical inspection issues.

SSE is involved in considering an OPT tolerance change issue. SSE rejected the initial Discrepancy Reports and required Thiokol to prepare material to support any OPT specification or requirement change.

SSE supported a TIM focusing on finding a replacement for Chrysotile Fiber (formerly known as asbestos) used in the insulation of the RSRM segments and other part of the RSRM (aft dome, igniter chamber, igniter adapter, igniter initiator, and flex boot).

SSE assisted in developing and participated in the Thiokol's presentation to the SSRP of the Current Design and Reliability Improvements, RTF Overview, System Safety Risk Management, and RTF Constraining Actions to validate that all controls are implemented properly to resolve PRCB actions related to (1) "Accepted Risk failure causes" and (2) "Working Group observations". The presentation was well received by the SSRP. The SSRP suggested delaying addressing the integrated hazard reports (RSRM failure causes) and to instead look at all failure causes (controlled and accepted risk) in the accepted hazard reports.

SSE witnessed the pre- and post-destruction of the actuator bracket test and attended the ETM-3's Test Readiness that was very successful.

SSE is supporting bi-weekly telecons TPS Operations vs. Certification team and process reviews at KSC a part of the SRB Return to Flight effort

SSE reviewed the 2003 Hazard Report annual update. SSE integrated comments and prepared a presentation that was given to SRB Chief Engineer, Program Manager and the configuration change board.

SSE continues to support ETA Ring Splice Plate telecons, Thrust Vector Control Fuel pump redesign, and the SRB Hold-down Stud redesign.

SSE supported the SSME system safety and reliability teleconferences, the "dry run" for the SSME chief engineers' teleconference (CET), the SSME CET, the SSME S&MA RTF status meetings, and also reviewed notes on SSME project status and recent technical issues

SSE completed evaluation of Rev. C of the Space Shuttle Contingency Plan and recommended it for approval as written, and completed evaluation of seven SSME changes and four Systems changes.

SSE has begun evaluating a list of CIL items that Rocketdyne proposes should be excluded from their on-going RTF assessments of the SSME hazard analysis and FMEA/CIL. A teleconference was held with Rocketdyne and Pratt & Whitney personnel on 07/31/03 to discuss the process and decision criteria.

System Safety Engineering (SSE) supported RTF efforts by participating in SSME hazard analysis re-evaluation at the Boeing-Rocketdyne facility at Canoga Park, CA on 08/26-28/03 and the SSME's high-pressure turbopumps at Pratt and Whitney, West Palm Beach, FL on 09/23-25/03.

Payload Safety Engineering (PSE) attended the ground safety technical interchange meeting with the ground safety review panel. Several clarifications were noted when filling out information for the ground safety data package Safety Verification Tracking Log (SVTL).

PSE supported NODE 2, NODE 3, ECLSS including WRS, OGS and OGA; MPLM, BTR/HHR, EXPRESS Rack and 14 other microgravity projects (BiC, DELTA-L, FOAM, FMVM, GEDS, ISSI, MFMG, MSG, MSG-Integration, MSRR-1, OPCGA, QMI, SHIVA, and TES) by conducting hazard analysis, participating in hardware design meetings, preparing Safety Data Packages (SDP), presenting to the PSRP successfully, updating Hazard Reports (HR) and SVTLs, and supporting multiple Flight Readiness Reviews.

PSE supported NODE 2 by updating flight HRs to address the Developed the Failure Detection Isolation and Recovery (FDIR) table for the Node 2 powered equipment that was agreed to by the SRP. PSE also continued to close NODE 2 Verification Closure Notice's related to accepted HRs, reviewed 10 International Space Station changes for impacts, and supported efforts to address approval of Boeing/KSC ground support equipment (GSE) that may be used in processing KSC.

The PSE supported the Flight safety review panel (SRP) special topics to discuss the ammonia leakage non-conformance report (NCR) that has been generated for Node 2. The SRP approved the NCR as modified to reference qualification and acceptance testing of the reversed secondary seal in the rational for approval.

PSE supported the reviewed and provided comments to the Node 3 Bilateral Integration and Verification Plan (BIVP) and Prime Item Development Specification (PIDS).

PSE was SRP assigned MSFC Node 3 Project an action (#SRP02-146) to define the Orbital Replacement Unit (ORU) maintenance tasks on the Oxygen Generating Assembly (OGA) to avoid the need to return to ground for repair/ maintenance after a cell stack failure.

PSE developed Verification Logic Networks (VLN's) for the NODE 3 verification activities.

PSE supported the Pre-Ship/Acceptance Review (PS/AR) for the Solar-B Extreme UV Imaging Spectrometer (EIS) Mechanism Driver Electronics (MDE) boards.

PSE supported the Multi Purpose Logistics Module (MPLM) Thermostat design meetings, normal team meetings, the Flight UF-4 portion of the Stage Integration Review (SIR 10) held at JSC, reviewed Space Station Change Notice (SSCN) 7919 (Resupply Stowage Platform Upgrades), the Alenia MPLM ground hazard analysis and provided comments. The PSE also arranged for a Ground Safety Review Panel (GSRP) MPLM Project telecon to discuss MPLM GSE.

PSE is currently working an issue with the Regenerative Environmental Control and Life Support Subsystem (ECLSS) use of a whole range of QDs supplied to the ECLSS Project as Station common hardware. A failure (QD came apart) of one of these QDs during vibration testing at Hamilton Sundstrand on one of the Oxygen Generation System (OGS) Orbital Replacement Units (ORUs) has caused the ECLSS Project at MSFC to call into question the design and qualification of all of the Parker supplied QDs (Station common hardware). The ECLSS Project intends to ask for a waiver in the event that these QDs are required to be replaced at a later date. Payload Safety does not concur with this approach. As a result, the ECLSS SPRT has agreed to write a Problem Reporting and Corrective Actions (PRACA) report on the QD failure. The TIM representatives also agreed on a test campaign to find the problems with the QD design and to requalify the hardware. The TIM representatives were not willing to issue an ALERT but did agree to report this problem to the Vehicle Control Board (VCB) to determine if some kind of advisory should be given to the Station program about this QD hardware. Payload Safety feels that a warning should have already been issued and is watching this situation closely.

PSE forwarded to the SRP on 07/14/2003, an analysis for the proposed option for replacing the OGA Orbital Replacement Units (ORUs) in the event of an OGA cell stack failure. PSE reviewed and commented on Engineering Change Request (ECR) for OGS.

PSE is working with the OGS team on interpretation of requirements for connectors, fittings, and fasteners in general.

PSE presented to the ISS Safety Review Panel a response to perform an assessment on Orbital Replaceable Unit (ORU) replacement versus entire rack replacement that was generated at the Node 3 Phase II SRP meeting on 09/4/03.

PSE reviewed a report concerning a material, Neoflon, CTFE M400H polychlorotrifluoroethylene (PCTFE), that may be prone to fires and determined that an MUA must be generated if this material is used.

PSE supported a telecon with the KSC Ground Safety Review Panel to address the phase II Ground Safety Data Package (GSDP) comments from KSC and the MSFC MSRR-1 team response to those comments. PSE also participated in the review of project-identified risks.

PSE submitted the SDP for the Spanish Soyuz Mission (Soyuz 7) and obtained approval by the PSRP.

PSE supported the Quench Module Insert (QMI) Test Requirements Matrix review. Each test should have specific pass/fail criteria, be clearly tied to specific test performance and provide clear path to the verification it is intended to support.

Payload Safety supported a successful Certificate of Flight Readiness Review for the Microgravity Science Glovebox (MSG) Integration Project.

The PSE participated in the Test Readiness Review (TRR) addressing the planned software verification testing for the DELTA-L avionics.

PSE reviewed and communicated comments on draft SDPs for Fluid Merging Viscosity Measurement (FMVM) and Structure of Viscous Liquid Foam (FOAM).

PSE prepared charts for the Gravitational Effects On Distortion In Sintering (GEDS) RDR scheduled for 10/01/03. PSE also updated the FTA to reflect design changes and comments to incorporate into the presentation.

PSE supported the successful In-Space Soldering Investigation (ISSI), Miscible Fluids In Microgravity (MFMG), Spanish Soyuz Mission (SSM) PSRP Reflight and Flight Certification Reviews.

PSE supported the successful Payload Safety Review Panel (PSRP) which resulted in several changes to the Safety Data Package (SDP) in response to changes in operations and materials for MFMG, then sent the signed package to the PSRP.

PSE supported the successful Observable Protein Crystal Growth Apparatus (OPCGA) Phase III Review.

PSE group established a Safety Metrics System for Flight and Ground Safety Review in support of QS30. A database will house all information and allow query for data /metrics.

4.2 Reliability

4.2.1 Reliability & Maintainability Engineering (R&ME)

In support of the Advanced Projects Assurance Department, Reliability and Maintainability Engineering (R&ME) continued providing Reliability and Maintainability (R&M) discipline support to the Orbital Space Plane (OSP) and Next Generation Launch Technology (NGLT)

programs. R&ME continued to lead the Vehicle RMS Working Group to identify and resolve R&M related issues with the three OSP architecture contractors. R&ME participated in the OSP Systems Operational Evaluation (SOE) and held several splinter meetings with the architecture contractor RMS personnel to coordinate issues. Additionally, R&ME reviewed and coordinated comments on the contractor RMS Plans, and participated in the development of Statement of Work inputs and Data Requirements Descriptions for the OSP contracts. R&ME attended an X-37 technical interchange meeting with Boeing to discuss progress in the development of the Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and other R&M issues, and participated in the X-37 Orbital Flight System (OFS) System Design Review activities and ALTV FMEA/CIL Tiger Team. R&ME participated in a Demonstration of Autonomous Rendezvous Technology (DART) reliability technical interchange meeting with Orbital Sciences Corp and their subcontractor, Futron, to discuss and resolve the remaining issues regarding the DART Failure Modes and Effects Analysis and mission reliability prediction. In the NGLT arena, R&ME has been an active participant in the RS-84 RMS team and NGLT Life Cycle Analysis Team (LCAT). R&ME also continued supporting the Jovian Icy Moon Orbiter (JIMO) project, and is participating in the planning and development of a number of risk reduction activities, including development of fault tree analysis.

In support of the Shuttle Assurance Department, R&ME is currently actively involved in Return To Flight activities for all of the propulsion elements, including review of CIL retention rationale and hazard reports. Additionally, R&M continued to support ongoing effort related to Shuttle Upgrades, including active participation in the ET friction stir weld process implementation, and the qualification process for the SRB Command Receiver Decoder and Altitude Switch Assembly. R&ME also participated in several SSME Reliability & Safety face-to-face meetings at KSC with a primary goal of improving center-to-center communications.

In support of the Cargo Assurance Department, R&M completed ISS program coordination and closeout of verification documentation to support the Node 2 requirements verification and Final Acceptance Review activities. R&ME continued development of the Node 3 FMEA/CIL and is in the process of incorporating feedback received from ISS R&M. At the request of the Gravity Probe-B project, R&ME reviewed the existing GP-B FMEAs and related documentation to compile a listing of single point failures for both the space vehicle and the payload, and coordinated it with project personnel to support risk mitigation activities.

4.2.2 Problem Assessment Center (PAC) Operations

HEI's PAC personnel processed and coordinated disposition of problem reports, coordinated the MSFC Problem Assessment System, supported various return-to-flight activities, and operated the Corrective Action System (CAS). The PAC received and entered 13 new problem report (PR) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of 9 PRs, received 4 prime contractor closure recommendations, supported MSFC full closure of 2 PRs, coordinated non-problem closure of 1 problem, and performed 82 individual PR database updates and reviews. PAC conducted 4 SSME problem review boards (PRBs) resulting in dispositioning 13 of 13 problem reports presented. The PAC generated or updated trends for MSFC Shuttle problems submitted as newly opened or for closure. PAC also generated and distributed monthly problem bubble trend risk charts and

briefed them at the monthly SRB Problem Assessment System (PAS) review. PAC reviewed 4 requests for access to the MSFC PRACA database and granted 3 of them.

In support of return-to-flight, PAC led MSFC's participation in Action 19-1 PRACA Re-evaluation. This included performing and briefing to the entire 19-1 Shuttle Team line-by-line evaluation of hardware prime contractor PRACA processing procedures and NASA requirements, review of the accuracy of processing PRACA and IFA reports for the last 3 shuttle missions, and offering suggestions for revision to internal and the NASA PRACA processes and requirements. It also included supporting briefing of these results to the PRCXB and assisting rewrite of the NSTS 08126 Shuttle PRACA requirements document. All of these activities were coordinated by the PAC with the various MSFC Shuttle Project Offices, S&MA Shuttle Integration, and the MSFC Shuttle prime hardware contractors. PAC has been participating in Data Mining for Periodic/Episodic/Repeating Problems, providing and reviewing data both from the MSFC PRACA and the KSC PRACA data systems.

In problem system coordination, the PAC conducted 2 SRB Problem Assessment System (PAS) status review for the SRB Chief Engineer, reviewed and reported on EXPRESS Rack's participation in PRACA, and reviewed and red-lined OSP requirements on problem reporting and trending. PAC assisted in coordination and made presentations at the SSME Reliability Face-to-Face held in Huntsville.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly HEDS new shuttle problem charts, monthly newly opened/closed problem summaries, weekly SRB PRACA and ALERT status reports, and quarterly Open Problems List (OPL). Special activities included: (1) verifying and updating as needed Critical Items List (CIL) and Hazard DCN references; (2) providing KSC SRB and ET connector saver and MLP TSM faceplate problems; (3) extracting and providing KSC PRACA launch data bus problems; and, (4) extracting and providing all KSC PRACA ET problems from 1996 through 2003 from both the webPCASS and KSC PRACA data systems. PAC also provided orientation on PRACA to the new SRB Assurance Team Lead.

(PWS 6.3.3) In implementation and operation of the MSFC Corrective Action System (CAS), PAC received 58 potential CAS reports, screened 57 draft Recurrence Control Action Requests (RCARs), and initiated 6 new RCARs. PAC received 6 responses from laboratory points of contact with either disposition rationale or response extension requests. PAC coordinated Corrective Action Board review of 1 RCAR, resulting in its full closure. PAC also provided and discussed CAS metrics and open RCAR status reports at the Marshall Management System (MMS) Implementation Team meeting, issued monthly RCAR status and delinquent response reports, and statused CAS activities at the Marshall Quality Council. PAC was surveyed by the NQA auditors for ISO 9001:2001 surveillance and AS9100 Certification, with no observations nor discrepancies being charged. PAC also revised retention schedules for some of our ISO records based on review and input by the MSFC Records Coordinator. RCARs receiving heavy activity and coordinated extensively by the PAC included RCAR 210 on Integrated Financial

Management System (IFM) processing of sensitive flight hardware inspections and RCAR 206 regarding NASA Research Announcement funding.

4.2.3 ALERT Program

HEI's ALERT support included both regular and special activities as HEI coordinated MSFC ALERT processing. HEI received and distributed 35 ALERT announcements for MSFC review and obtained 1,964 responses from MSFC project, contractor, and laboratory contacts. HEI ALERT support included: (1) reviewed and approved 9 new MSFC ALERT database accounts via the TPS security. HEI generated monthly Open, Delinquent ALERT response tabulations and provided them to S&MA and/or Directorate single points-of-contact responsible for open ALERT reduction; (2) participated as secretary to the GIDEP Industry Advisory Group (IAG) at the Quarterly GIDEP Business Meeting in Albuquerque; (3) prepared and submitted charts on MSFC's closed-loop ALERT processing technique for presentation at the GIDEP Annual Clinic in November; (4) assisted processing of ALERTs by the MSFC projects and directorates; (5) defined, coordinated among other NASA Centers, and submitted to NASA HQ revisions to NASA's ALERT processing requirements; (6) implemented software system enhancements which notify ALERT actionees of coming delinquent ALERTs and allows 30-day extensions of response date under certain conditions; and, (7) reviewed and revised OSP's ALERT data requirement and statement of work. HEI was instrumental in MSFC obtaining GIDEP's Achievement Award for 2002.

4.3 Quality

Space Transportation

External Tank (ET) Quality Engineering (QE) participated in Return to Flight (RTF) activities with the review of the ET Bipod Redesign Preliminary Design Review (PDR) package and preparation of Review Comment Actions (RCAs) to be answered during the PDR review at Michoud Assembly Facility. In addition, ET Quality Engineering participated in numerous Test Readiness Reviews and reviewed numerous test plans and procedures for development and certification tests conducted for RTF activities. ET Quality Engineering continued day-to-day activities with participation in the monthly ET Quality Escape telecon and preparation of the Quality Escape Reports. ET Quality Engineering also participated in the ET Thermal Protection System Working Group to evaluate a sub-tier supplier change impacting the NCFI foam system and the resulting impact to RTF activities. ET Quality Engineering is also participating in an ongoing investigation into Lockheed Martin employee certification and On-Job-Training practices.

Solid Rocket Booster (SRB) QE supported the following return to flight activities: (1) review of pyrotechnic hardware Source Inspection Plans for compliance to Critical Items List and supporting inspections; (2) weekly pyrotechnic hardware meeting; (3) Chief Engineer's Nonconformance Information System Problem Report Meetings; (4) review of SRB test plans and procedures; and (5) evaluation of Engineering Change Proposals.

Space Shuttle Main Engine (SSME) QE supported/participated in the following SSME Project activities: (1) cracked BSTRA ball investigation; (2) Orbiter OV-104 Main Propulsion System contamination investigation; (3) Critical Design Review of the LTMCC units 6016 and 6019

which were being considered for re-entry into the flight program; and (4) assessment of the gimbal test article flowliner.

Reusable Solid Rocket Motor (RSRM) Quality Engineering reviewed engineering change proposals, process change proposals, and Material Review Board items for quality and certification impact. Quality Engineering also attended and reviewed information presented at RSRM milestone reviews, and weekly RSRM propellant, liner, and corrective action reviews. RSRM Quality engineering has continued to act as the S&MA main point of contact for the RSRM Propellant Structural Analysis issues and pending waiver and for the recent liner bubbling and contamination issues. RSRM Quality Engineering also continues to lead weekly reviews of Thiokol's corrective actions.

QS20/QS40 Quality Assurance (QA) continued to support the JG-PP Lead-Free solder project and the workmanship and training requirements development of the J-STD-001 and NASA Addendum contract, with ACI Technologies. Additionally, QA supported the Preliminary Design Review/Critical Design Review at Lockheed Martin.

Software Quality Assurance (SQA)

Software Assurance (SA) received a Group Achievement Award presented by Jack Bullman/Avionics Department to members of the Flight Software Group (ED14) and SA (QS40) for their participation in obtaining a Capability Maturity Model (CMM) Level 3 rating from the Carnegie Mellon Software Engineering Institute (SEI). ED14 is the first NASA organization successful in achieving a CMM Level 3 rating. SA also provided expertise to the ED14 FSG Software Process Improvement (SPI) review and insight activities, and planning sessions for the SEI Capability Maturity Model - Integrated (CMMI). The FSG and SA planning effort will include impacts associated with transitioning to the CMMI staged or continuous models and the level of assessment.

SA reviewed the GLAST Burst Monitor Software Development Plan (SDP) and related documentation submitted in response to two Requests For Action (RFAs) initiated by SA at the GBM Flight Software Critical Design Review (CDR). Comments generated by SA were incorporated into project documentation, and revisions were reviewed and agreed to by SA for RFA closure. SA also attended and reviewed documentation for the GBM Data Processing Unit (DPU) and Flight Software Critical Design Review conducted at the National Space Science and Technology Center (NSSTC).

SA reviewed the Materials Science Research Rack (MSRR) Master Controller (MC) Software Requirements Specification (SRS) Volumes I and II, and Master Controller (MC) Development Unit (DU) Software Test Procedures. Test Procedures are being evaluated to assure traceability to the Software Requirements.

After review of the SHIVA Software Development Plan, SA prepared a draft Software Quality Assurance Plan (SQAP) describing QS40 SQA activities to be performed during SHIVA Flight Software development and test.

ISO9001/AS9100

Quality Engineering has continued to play a key role in ensuring the maintenance of ISO 9001 and AS9100 at MSFC during this time period. Efforts have dealt with continuing implementation of ISO 9001 and AS9100, maintenance of documentation, and planning and support for the NQA registrar audit, including preparation of self-assessment checklists for the MSFC organizations, and follow-up and closure of corrective actions. Quality Engineering provided general ISO and AS9100 support, including reviews of both MSFC and NASA Agency documentation, training, Marshall Quality Council (MQC) meeting preparation, and consulting support on internal audits, training, records, document control, planning for process changes (including implementation of ISO 14001), the deviation/waiver process, and other aspects of ISO 9001 and AS9100, to various MSFC Organizations. Quality Engineering also participated in a NASA Agency Quarterly Quality System Status Review meeting at NASA Headquarters.

Payloads

QE performed Drawing Reviews, Procedure Reviews, Test Readiness Reviews, Procurement Reviews, Inspection Requirements, Shipping Requirements, and/or supported team meetings for the following projects: MPLM, BiC, BRP, UF-4, EGN, TES, OPCGA, Delta-L, ECLSS, QMI, SHIVA, GBM, MSRR, GP-B, Solar-B, MSG and GEDS.

QE accomplished the following project related tasks: (1) review of verification closures for OPCGA, TES and ECLSS; (2) provided quality expertise to Material Review Boards for ECLSS, MSRR, g-LIMIT and MSG; (3) reviewed Acceptance Data Package (ADP) for the ECLSS Waste Water Storage Tank Assembly; and, (4) wrote a S&MA plan for SHIVA and BiC, and a Letter of Delegation for BiC.

QE provided support to the following project related reviews: (1) preliminary Design Review (PDR) for Coupled Growth in Hypermonotectics and Particle Engulfment and Pushing by Solidifying Interfaces (CGH/PEP) Sample Ampoule Cartridge Assembly (SACA) project; (2) requirements Definitions Review (RDR) for the Gravitational Effects on Distortion in Sintering (GEDS) Project, Certificate of Flight Readiness Review and Acceptance Review #3 for MSG Project; (4) Critical Design Review (CDR) for the Glass Burst Monitor (GBM) Project.

QE performed as-built versus as-designed comparison of UF-4 Handrail Assembly hardware and provided response to the Independent Assurance Assessment Report Narrative MH-2001 for the BiC Project.

Inspection and Test

QS10 Quality Engineering reviewed and released procedures for the test facility build up and the testing of the Northrop Grumman composite tank, the Laser Ignition system, the Goddard Flight Replica, and the Shuttle investigation testing. Quality Engineering provided metrics for problems noted during test preparation sheet review and approval.

QS10 Quality Assurance (QA) provided support in all MSFC test areas by monitoring operations to/with test engineers and contractor support personnel. LN2 Cryogenic Valve timing operations at Test Stand 500, METCO Combined Environmental Facility at the Hot Gas Facilities, RSRM Nozzle materials testing at the Solid Motor Torch Test Stand, Long Life Thruster testing at Stand

115, and proof test of the BSM Igniter housing at Test Stand 101 are among the test supported by Quality Assurance.

QS30 Quality Assurance personnel monitored vacuum baking procedures at the environmental test facility at Bldg. 4619. QA personnel performed receiving inspection on various flight items at NASA quality office in Bldg. 4705. QA witnessed and monitored test and assembly activities for ECLSS, WRS, UPA, Delta-L, OGA, MSRR, MGM, PCG and ProSEDS. QA personnel performed surveillance and inspection of Solid Rocket Booster Bolt Catcher Testing in support of CAIB Testing. HEI provided on-site QA support to GP-B at Stanford University during this period.

4.4 Information Management (IM)

Information Management (IM) completed development of several applications during the period. SHEtrak, which will be used for tracking Safety, Health and Environmental inspection findings, was completed, tested, and approved for deployment by the Chief Information Officer (CIO). The interfaces that SHEtrak provides to various data sources, such as the Facilities Work Order system, will significantly improve processes by providing easy access to updated information as well as the ability for the responsible personnel to interface directly with the application. IM spearheaded efforts to interface MSFC processes in support of the application and developed two update programs to maintain the interfaces. The Virtual S&MA web site, which provides a standard structure for S&MA pages and allows update by selected personnel through a database-driven interface, was also deployed. IM also developed the Safety Observation Surveys (SOS) for submitting anonymous information about Unsafe Acts, Printable Posters for access to Safety posters, a draft Safety Review Database to track issues resulting from reviews, and the revised Space Flight Awareness (SFA) application. The SFA application will be deployed following in-house for compliance and subsequent beta testing by the Curator. Applications modified during the period include Safety Bulletins, Safety Concerns Reporting System, Supervisor Safety Web Page (SSWP), Safety Search, Training, Slogan, S&MA's integrated login application (TPS), ALERTS, and IHOPs. The changes to SSWP included development of a module for use by internal auditors and QS50 personnel in reviewing an organization's open findings as well as completion of a Frequently Asked Questions (FAQ) page. IM took the initiative to provide the FAQ page to improve customer support and to modify TPS to improve security provisions.

Security activities performed during the period include updating risk assessments; revising the security plan for web-based applications; updating the SSL certificates on S&MA servers and then procuring and updating replacement certificates; and performing security updates on and developing security plans for a non-ODIN pc and a replacement configuration management server. IM personnel also attended training sessions to prepare for required system administration certification. In addition, IM supported HEI personnel in updating desktop systems to assure that adequate virus protection measures were implemented. Monthly summary reports of security activities were provided to the IT Manager (ITM) and Organizational Security Official (OCSO).

IM participated in three NASA-wide Information Technology activities. IM represented MSFC in an evaluation of a visualization tool for potential benefit to RTF activities. IM also assisted in coordinating actions associated with implementation of a replacement Incident Reporting

Information System (IRIS). IM developed a security plan for an IRIS module that will be used by the Medical Center to assist in resolving impediments to implementation. In addition, IM performed significant data manipulation activities and coordinated with Headquarters personnel in order to transfer MSFC SFA data; IM is working with HQ to establish an automated interface between the MSFC and the HQ SFA databases.

Other support activities include: (1) significant data manipulation and support of the NASA Small Business Engineering-Manufacturing showcase to support the Audited Vendor List (AVL) and Limited Vendor List/Project Specific Approved Vendor List (PSASL) applications; (2) preparation of Customer Satisfaction/Feedback reports for a quick-turnaround request (quick response); coordination of activities to support the Safety Day web site; (4) attending meetings and providing data in support of numerous ITM activities; and, (5) coordination of multi-user application software deployment and updates.

4.5 Human Exploration and Development of Space (HEDS) Assurance

4.5.1 International Space Station (ISS) Independent Assurance

A collaborative assessment with JSC and KSC IA has been developed for determining the health of the Independent Assessment (IA) of ISS SR&QA/S&MA (JSC, KSC, MSFC) Stage Operational Readiness Review (SORR) & Flight Readiness Review (FRR) Certificate of Flight Readiness (COFR) Review Process (JKM-3002). Interviews are complete. MSFC IA personnel participated in teleconferences and provided written comments to JSC to finalize observations/recommendations and the assessment out-briefing presentation. The observations/recommendations were finalized and thoroughly discussed with applicable MSFC S&MA Management prior to the formal out-briefings. The outbriefing of the Payload Operations Integration Center Safety Independent Assessment was given to Tony Lavoie, the Flight Projects Directorate acting director. Also discussed with Mr. Lavoie were the responses to the actions received as a result of the Outbriefing to the International Space Station Safety and Mission Assurance/Program Risk Office Manager, Jim Wade, JSC Code OE, on July 30.

Progress on Assessment MH-2001, Evaluation of MSFC ISS Payloads: IA Conducted an out briefing with the Manager and appropriate members of the Microgravity Science and Applications Department, Science Directorate (SD40) on 7/11/03. IA is awaiting responses from SD.

MSFC IA received comments from the MSFC S&MA Cargo Assurance Manager relating to the flow down of SSP 50431 into MSFC ISS payloads assessment MH-2001. Comments were evaluated and a follow up memo was issued requesting additional information. Additional comments have been received and are being evaluated.

IA participated in the Mission 7S Prelaunch Assessment Review. There were no issues related to MSFC.

4.5.2 Space Shuttle Independent Assurance

The Independent Assessment of MH-2013 has been finalized and is closed out. The Test Readiness Review (TRR) of the Thiokol Engineering Test Motor (ETM-3) September 22-23 at

ATK/Thiokol in Utah was monitored by IA to assure that the actions from the IA Review have been addressed and those that are "test constraining" are closed.

IA completed Independent Assessment MH-2011, Procurement Quality Control at Lockheed Martin Michoud, with a debrief to the ET Project Manager. The final report is in review. Since this assessment was a project led assessment, not all of the IA questions were answered. A second assessment with a more detailed look at procurement flow down of requirements will be performed.

IA completed Independent Assessment MH-2012, Evaluation of MAF Lifting Equipment Maintenance/Repair and Personal Certification Process, with a debrief to the ET Project Manager. All actions and recommendations were accepted.

The Assessment Team of KSC GSE that interfaces with SSP Flight Elements continue to review documentation in support of the referenced assessment effort. The Assessment Plan has received approval by Code Q and the three IA Groups (at the affected NASA Centers). In addition, the "in-brief" was presented on September 26, 2003, and was well received by all participants in the telecon. MSFC Assessment Team members continue to research Shuttle support GSE systems, and are preparing lists of problem reports (PRs) that have been written dealing with connector saver failures, corrosion on connector pins, and failure of mechanical support hardware. The team is also investigating connector and connector saver locking devices, and is reviewing documentation/hardware to better understand these components. A telecon was held with the Chief Design Engineer at Glenair, a connector and connector saver vendor, to discuss certain design characteristics and potential problem areas related to the use of these components. The Team is working on a "checklist" to be used during personnel interviews, at KSC, that are tentatively scheduled for mid-October. This is an ongoing effort, and more information will be provided as it becomes available.

An Independent Assessment meeting to address the corrosion of umbilical pins as a common cause failure mode was held with HEI SRB Reliability engineers to brief them on the Anomaly Issue and Independent Assessment at hand and to acquire their Reliability expertise on this failure mode relative to the Reliability requirements for the Space Shuttle Program as contained in NSTS 22206. The major issue at hand is that since corrosion on the umbilical pins will, under launch environments, periodically and unexpectedly cause a loss of some electrical functions, the redundancy that is thought to exist is in question for certain Criticality 1R circuits. Unfortunately, the NSTS 22206 ground rules for GSE, do not require a FMEA to be performed on wire harnesses and cables. However, since these cables and PIC Racks perform safety critical functions, there is cause for further analysis and perhaps a recommendation to the Program for exceptions. This evaluation will be carried further within MSFC and probably to the IA Team for discussion and adoption as either an observation with recommendation or a finding.

Independent Assurance participated in a Space Shuttle Return to Flight (RTF) telecon in support of PRCBD #S061954R5, Item 19-1. The title of the activity is to "Identify Problem Tracking, IFA Disposition, and Anomaly Resolution Process Changes", and the task was to audit the last 3 Shuttle flows (STS-112, -113, and -107) for specific data. The HEI Problem Assessment Center (PAC) manager addressed items investigated by the Team in response to questions asked.

IA participated in a Thermal Protection System Manual Spray Team meeting and a recommended roadmap for future processing work was presented to Denny Cross, Acting ET Project Mgr. and Neil Otte, Deputy ET Program Mgr. IA proposed two recommendations, both of which were accepted. The first recommendation was to establish a PAL ramp processing team. The second recommendation was to focus on the expeditious development of plans for the first two boxes of the roadmap (development and enhancement) so critical work can proceed and develop the plan for the remaining roadmap boxes.

IA met with Chief Engineer of the ET Program and separately with Scotty Sparks and other M&P personnel to discuss the Protuberance Aerodynamic Load Ramp working group activities and to identify and assess any differing opinions between the groups relative to requirements for return to flight. IA also met with the lead for the TPS Verification team, to review the TPS Manual Spray Team report and the Plans for Rework of the LH2 Flange presentation. Both reports are being prepared for the ET project Office.

4.5.3 Space Launch Initiative Independent Assurance

IA has completed the Independent Assessment MH-3004, Assessment of the Orbital Space Plane PAD and DART projects. The final report has been submitted for posting to the IA Website.

MSFC IA personnel met with the S&MA Lead for the Advanced Propulsion Assurance Team for Next Generation Launch Technology (NGLT) to discuss organizational structure, management, and current work activities. The S&MA Lead alerted level one NGLT Management to IA activities in NGLT and notified them that they will be contacted by IA personnel for face-to-face discussions on how IA can integrate value added assessments into the early development of the Program.

4.6 Project Assurance

PAE represented the OSP Program Integration Office (PIO) at the PAD Abort Demonstration (PAD) Preliminary Design Review (PDR) conducted at the Lockheed Martin location in Denver, Colorado. Issues were identified and forwarded in the form of review item discrepancies to the PDR Board for acceptance and incorporation of corrective measures.

PAE, in support of the PIO, participated in the preparation of the mod-2 Data Requirements Descriptions (DRD)s and Statement of Work that were forwarded to the prime OSP contractors (Lockheed Martin, Boeing and Northrop Grumman/Orbital Science) as a Request for Proposals for the period that covers the end of the current contract to PDR.

PAE concluded the Axiomatic Design for the OSP Minimum Functionality Study. The study was to identify the minimum functionality expected from the OSP and a decomposition of the top functions to the subsystem levels. The study was so comprehensive and complete that it is being considered to be baselined for reference in future negotiations with the prime contractors.

PAE participated in the OSP System Operations Evaluations (SOE) conducted by the three prime contractors (Lockheed Martin, Boeing and Northrop Grumman/Orbital Science) in July 03. The contractors identified their candidate architectural selections that will become the candidates for

a final OSP architectural choice that will be finalized at System Design Review (SDR) in November 2003.

PAE participated in the OSP System Requirements Review (SRR) conducted by the three prime contractors (Lockheed Martin, Boeing and Northrop Grumman/Orbital Science) in September 2003. The contractors further refined their candidate architectural selections and presented their most likely candidate architectural choice for OSP. The architectural will be finalized at the System Design Review (SDR) in November 2003.

PAE participated in the AIAA held in Long Beach, CA, on September 22-24, 2003. The main topic of discussion was the Columbia Accident, Safety and NASA's future.

ET PAE has provided S&MA and technical direction on the Intertank/Liquid Hydrogen Tank flange enhancement team in support of the ET RTF activities. The objective of the team is to eliminate/reduce the potential of debris from this large closeout area. The team has been pursuing identifications foam loss mechanisms and the potential mitigations.

ET PAE reviewed and approved a test plan to determine a failure mechanism for foam loss in the Intertank/LH2 Tank closeout region. The objective of the test is to perform testing on mini (1'x1') foam specimens with intentional voids under various environmental conditions and determine the failure modes within the foam. A design of experiments (DOE) has been developed using void size, void location, flight-like delta pressure (vacuum), tanking cryogenics, and ascent heating as the variables. The test indicated that a void close enough to the exterior surface would cause foam loss (debris) when submitted to flight environments.

ET PAE along with MSFC Materials and Processing (M&P) Engineering witnessed and assessed several enhancement efforts relative to the manual foam closeout of the ET Intertank/LH2 flange area. In-flight foam loss in this region has been attributed to voids within the foam closeout. ET PAE and MSFC M&P concluded that the manufacturing plans/instructions for these closeouts do not provide sufficient detail to perform a repeatable process. ET PAE identified potential deficiencies in the existing risk mitigation due to these manufacturing processes and the lack of quality inspections. These concerns were communicated to Lockheed Martin Safety and Reliability and NASA S&MA.

ET PAE evaluated and approved a test plan for the replication of the foam loss mechanism in the Intertank/LH2 tank closeout region. The objective of the test is to utilize current processes on a section of the joint closeout and induce flight environments on the test article in the attempt to replicate in-flight foam loss. Also, several panels were fabricated with engineering voids within the foam. Data from this test supported foam loss mechanism theories and is leading to corrective enhancements. ET PAE verified that proper quality requirements were imposed on the test plan. ET PAE performed post-test evaluation on the test panels. One of the panels exhibited several foam failures during the test providing engineering data for foam loss root cause. ET PAE identified a new potential failure cause in the foam that could lead to debris. The cause is associated with the out-gassing of Liquid Nitrogen from the Intertank purge system. The out-gassing of the LN2 results in cohesive failure in the TPS, which could potentially lead to debris generation.

ET PAE provided S&MA and technical direction in the RTF effort to remove Liquid Nitrogen (LN2) formation in the Intertank/LH2 Tank internal interface. During tanking operations, a nitrogen purge is used in the Intertank. Due to the cryogenics from the LH2 tank, the gaseous nitrogen condensates to form liquid, and subsequently, frozen nitrogen in the internal region of the Intertank/LH2 tank joint. This formation of frozen nitrogen increases the propensity to generate TPS debris from the intertank foam closeout region. ET PAE verified that proper quality requirements were imposed on the testing. Following the testing, ET PAE engaged in a Technical Interchange Meeting (TIM) at MAF to discuss test results and potential purge options. ET PAE assessed that the baseline nitrogen purge is unacceptable and full-intertank helium purge as the best option in regards to safety. This assessment was inputted into design trade study being performed.

ET PAE participated in the System Safety Review Panel (SSRP) Technical Interchange Meeting (TIM) held at Lockheed Martin/MAF. The objective of the TIM was to obtain SSRP concurrence with ET Project approach for updating Hazard Analyses and Failure Modes and Effects Analyses / Critical Items List for the return-to-flight activities. ET PAE voiced concerns relative to Lockheed Martin's evaluation. These concerns included current depth of the ET fault tree analysis, level of analysis of undocumented risks, assessment of current controlled risks, lack of necessary resources, and lack of proactive tools for risk mitigation. ET PAE presented an example fault tree analysis that expanded the baseline fault tree to the FMEA/CIL cause level. These issues were included in the SSRP's final observations and recommendations.

ET PAE evaluated rationale for not removing and reworking the Intertank/LH2 Tank foam closeout located beneath LO2 Feed Line, Press Line, LH2 Cable Tray and LH2 PAL Ramp. The rationale revolved around the increased risks associated with removing the ET hardware to be able to access the flange closeout region versus the current risk of losing foam and the generation of debris. ET PAE submitted the evaluation to the ET Return-to-Flight S&MA management.

SRB PAE supported QS20 during the SRB BSM Igniter Redesign Phase II Review conducted at United Space Alliance (USA) subcontractor, Pratt & Whitney Space Propulsion (P&W) September 12 -19, 2003. The purpose of the phase review was to conduct a technical assessment of the engineering drawings for the redesigned igniter components and review of related manufacturing, inspection and test planning documentation. Thirty-eight documents were reviewed and approved by the phase review team. The Phase Review was instrumental in authorizing the documentation necessary for the supplier to proceed with the manufacture of hardware in support of development, qualification and flight production.

SRB PAE supported the BSM Open Igniter Test Anomaly Resolution Team (ART) activities investigating erratic pressures observed during open air igniter qualification testing of new sources for Boron Potassium Nitrate (BKNO3) and Ammonium Perchlorate (AP) at United Space Alliance (USA) subcontractor, Pratt & Whitney Space Propulsion (P&W). Through rigorous testing and inspection, the ART was able to identify the causes of the erratic pressure and recommend igniter hardware redesign to eliminate the contributing causes.

SRB PAE represented QS20 during the SRB Frangible Nut Phase III Review conducted at United Space Alliance (USA) subcontractor, Pacific Scientific Energetic Materials Co. 09/30/03 – 10/02/03. The phase review team included representatives from MP41, United Space Alliance (USA) Design Engineering, Materials and Processes Engineering and Vendor Quality Engineering. Seventy-six Lot AAS frangible nuts were presented for Phase III acceptance. The hardware was not accepted due to open nonconformance documentation, hardware surface finish discrepancies and various documentation errors/omissions that must be resolved. Hardware acceptance will be revisited upon resolution of the deficiencies.

SRB PAE represented QS20 on the BSM/Pyrotechnics Ops. Vs. Cert Review Team and tracked other HEI SRB team member assignments relative to the activity. The Ops. Vs. Cert review was designed to provide an assessment of operations performed on critical hardware and determine whether hardware qualification limits may be exceeded. The review is on going.

SRB PAE supported the redesign activities relative to the Forward Separation Bolt Catcher. The current design was deemed unacceptable during the STS-107 SRB Working Group investigation and testing performed during the investigation pointed towards elements of the design that must be improved. To date, PAE has participated in design documentation and test planning documentation review.

SRB PAE has supported QS20 in return to flight activities by assigning and tracking SRB HEI team responsibilities relative to SRB CIL and Hazard Report (HR) assessments. The team's review has focused on debris related CIL's and HR's and a re-assessment of the controls for all "Accepted Risk" Hazards.

SSME PA is heavily involved in the current RTF effort. PA is a member of several RTF teams (OMRSD, Hardware Qualification and Certification, Mid-life Certification, etc.) and serves as the S&MA expert and fulfills the independent assessment function. PA is also responsible for ensuring RTF meeting coverage by the SSME S&MA team in the event that personnel are unavailable.

SSME PA participated in the SSME S&MA Reliability Face-to-face Meeting held here in Huntsville. Personnel from Rocketdyne and Pratt & Whitney, that work in the problem reporting system, were in attendance. These yearly meetings are held to assess the health of the problem reporting system (Unsatisfactory Condition Reports, ie. PRACA) and discuss modifications that should be considered. This years meeting also involved discussions of pending NSTS 08126 updates as a result of the Columbia tragedy, as well as the RTF plan for the Unsatisfactory Condition Reports (UCR) system.

SSME PA has supplied extensive material and data to a team that is assessing S&MA functions across all elements. Systems that have been analyzed so far include the: Certificate of Flight Readiness process, Material Review process, and Pre-Flight Assessment effort.

PA participated in the Orbital Space Plane (OSP) Northrop-Grumman Orbital Sciences (NGO) Systems Operations Evaluation (SOE) review. PA evaluated Northrop-Grumman Corporation (NGC) and Orbital Sciences Corporation (OSC) performance for the past quarter. Evaluation

was based on quality and timeliness of deliverables, with particular emphasis placed on 935A SA-010, the NGO Safety and Mission Assurance (S&MA) Plan. PA attended NGO OSP Contractor System Requirements Review (CSRR) briefings. QA participated in NGO OSP CSRR Reliability and Maintainability (R&M) splinter meeting. Discussions lead NGC to see that their model for deriving Probability for Loss of Crew (PLOC) was broke. It is expected that if this model is used again in the OSP Program that it will be revised accordingly. QA evaluated and consolidated comments as Office of Primary Responsibility (OPR) NGO Documents 931 SA-005, 931 SA-006, 935 SA-006, 935 RM-012, 935A SA-010, 935A SA-010 RevA, 935A SA-010-3, 935A SA-010-3, 935A SA-010-6, and 935A SA-010-8. QA evaluated and provided comments on NGO SRR documents: 935 SE-024, System Specification for the OSP; and 935 SE-027, System Requirements Analysis for OSP Development.

HEI PA has created a matrix detailing the support provided to QS30 in the areas of System Safety, Quality, and Reliability/Maintainability. HEI PA has met with the QS30 Team Leads and S&MA Leads to discuss details about the adequacy of support they are receiving from HEI. Careful attention is devoted to anticipating future resource requirements, and balancing available manpower with the needs of all the projects currently being supported.

4.7 Risk Management and Risk Assessment

4.7.1 Risk Management

There were several training requests during this period but each time the training was scheduled, it was subsequently cancelled by the requesting project because of scheduling conflicts and shifting priorities. There were however much activity in CRM infrastructure development and program support for the Orbital Space Plane program.

HEI Risk Management Project Assurance Engineering (PAE) provided expert consultation to the Shuttle Environmental Assurance (SEA). The request for support came through QS20 when the SEA team lead in the Shuttle Integration Office needed assistance with risk mitigation processes and practices. PAE met with the SEA risk management team and provided the information they needed to develop risk mitigation strategies for the shuttle environmental issue.

In a quick turnaround action, PAE was asked to review a Space Shuttle Program change request (CR) that would incorporate the continuous risk management process into the Shuttle Program. The CR was reviewed and PAE immediately attended a teleconference with the Shuttle Program Safety Director. PAE was able to provide timely information to the Shuttle Safety Director about the status of the Integrated Risk Management Application (IRMA) that was proposed by the CR. IRMA is currently being upgraded by the OSP program to address security issues that the Shuttle program was not aware of.

HEI Risk Management PAE developed a proposal to combine the efforts of S&MA and the Chief of Finance Office in building a capability to perform quantitative schedule and cost risks assessments. This capability will better enable projects to understand how technical risks will be reflected in terms of cost and schedule and will allow the project to make informed decisions concerning allocation of resources to mitigate those risks. This is an ongoing effort that will continue to be pursued during the next year.

HEI Risk Management PAE developed a draft risk management plan for the OSP Program. HEI brought in a subcontractor, Futron Inc. to assist in final development of the plan. PAE participated in meetings and workshops held with the OSP project and Level I and Level II program offices to capture best practices and project expectations for the OSP risk management process development. This resulted in further refinements to the plan with two additional tabletop reviews. The OSP Risk Management Plan has now been baselined. HEI is now working to further refine this document and to add two additional appendices/annexes to the OSP Risk Management Plan: the OSP Risk Management Summary Card (under development) as Annex A and the OSP IRMA process guidelines (under development) as Annex B. PAE has taken the program specific CRM processes defined in the baselined plan and has developed an OSP specific CRM training package. This will be a one-day course with ½ day of instruction and a ½ day risk identification workshop.

In parallel to the OSP planning and training activities, PAE assisted the OSP Program Risk Manager in refining the OSP top program risk statements. These risk statements were used in a briefing to upper management at MSFC and NASA Headquarters.

4.7.2 Space Shuttle Probabilistic Risk Assessment (PRA)

Risk Assessment (RA) continued to support the Shuttle Probabilistic Risk Assessment (PRA) activities, including preparation and data coordination for the PRA Independent Peer Review (IPR). RA is directly supporting the ET, SRB and SSME PRA IPR efforts, and has assisted in adjustment of the models in response to internal project review comments and comments from the PRA technical lead. All of the propulsion modeling is complete. RA is directly involved in compiling the required documentation for each of the MSFC Propulsion Elements for both MSFC and JSC, including the IPR.

4.7.3 Reliability Prediction & Risk Analysis

RA extensively supported the ET Working Group for the Columbia Investigation. RA represented ET S&MA at pre-test meetings and a test for ET Working Group Wind Tunnel testing at Arnold Engineering Development Center. RA produced an analysis of bipod foam loss and production data requested by the ET Working Group TPS Subteam and the ET Return to Flight Working Group. An analysis of environmental and production factors which may have affected bipod foam loss, and whether foam loss could have occurred on flights that have no photographic record. The results were reported to the CAIB. Additionally, RA discovered a quality issue with a method proposed to be used to measure SRB ETAR Splice Plates. Some team members had asserted that Rockwell hardness measurements had little enough variability to be used without considering that variability. RA located data, interviewed an ASTM representative and performed an analysis on the data and found that the data was in fact quite variable, and that the calibration curve from ASTM A370 proposed to be used was possibly non-conservative. The analysis was used to sell the team on the use of a more conservative approach, which was adopted by the team. RA was a key part of a team providing additional analyses to determine the number of samples needed to be taken from splice plates and rings in order to clear them for flight. This plan was adopted. RA performed an analysis of Shuttle launch delays over the life of the program to be used for benchmarking Orbital Space Plane requirements for Launch Availability (LA). RA suggested a sample size for a test that would characterize the

velocity of bolt parts in order to write allowables for SRB Bolt Catcher redesign. RA attended the 40th anniversary Space Flight Awareness ceremonies in Washington, DC as an honoree.

4.7.4 OSP Risk Assessment

RA continued to support the OSP RMS team by coordinating and organizing team meetings, telecons, issues, comments, documentation, actions, etc. Major activities of the RMS team included development and coordination of the OSP PRA Plan and PRA Process document. Additionally, RA supported ongoing OSP feasibility and trade studies and other special studies as required, including an assessment of the risk to the ISS associated with the DART mission. RA also established and led the OSP PRA working group to plan and coordinate OSP PRA activities with multiple NASA centers and contractors, and coordinated development of the PRA Plan and PRA Process Document. RA also participated in the development of the initial OSP PRA model, including master logic diagrams, mission phases, flight regimes, and construction of event trees. This task involved extensive coordination with other NASA centers, including JSC, KSC, and Langley as well as oversight of the Futron subcontracted effort.

5.0 COST REDUCTION ITEMS

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicious acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.